Center Independent Research & Development: JSC IRAD

Development of an End-to-End Active Debris Removal (ADR) Mission Strategic Plan

Completed Technology Project (2011 - 2012)

Project Introduction

The original proposal was to develop an ADR mission strategic plan. However, the task was picked up by the OCT. Subsequently the award was de-scoped to $30K to collect light curve data to characterize the tumble motion of potential ADR targets. This information is very critical to identify the technologies that will be needed during the proximity operations, including rendezvous and docking, for future ADR mission planning.

Since the majority of the potential ADR targets are large (>meters) upper stages and payloads between 800 and 1100 km altitude, they are relatively bright, with visual magnitudes ranging from 5 to 7. Small telescopes are sufficient to collect their light curve data. However, due to the potential high tumble motion of the targets, a CCD camera with a frame rate up to 30/sec is needed. Identify an existing group with the necessary facility, equipment, experience, and capability for light curve observations of potential ADR targets in the low Earth orbit (LEO) region. Collect light curve data of at least 100 major ADR targets, including SL-8 Cosmos 3M second stages (2.4 m diameter by 6 m length; 1400 kg dry mass) and SL-16 Zenit second stages (4 m diameter by 12 m length; 8900 kg dry mass). Process raw data, obtain light curves, and analyze the data. Outcomes: A 4-month contract with the Air Force Academy was established in 2011. The Air Force Academy used one of their 16" telescopes equipped with a fast Andor CCD camera for the observations. A total of 126 targets were observed during the 4-month period (ended in February 2012). About half of the targets had multiple passes. All raw data were processed, and summary spreadsheets for individual targets were prepared and delivered by the Air Force Academy. Two abstracts on the observations and the implications for the tumble motions of the ADR targets for the 2012 International Astronautical Congress were submitted and accepted for presentation.

Anticipated Benefits

Orbital debris is one of the Grand Challenges, but is not included in the Technology Area Roadmaps. The 2010 National Space Policy directs NASA and DoD to “Pursue research and development of technologies and techniques to… remove on-orbit debris.” One of the Grand Challenges identified by the OCT is orbital debris.

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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Independent Research & Development: JSC IRAD

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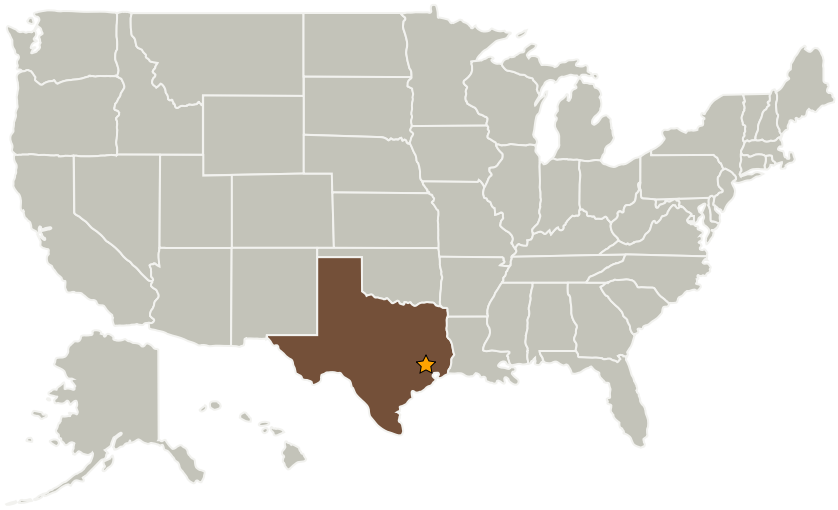
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations
Texas

Project Management

Program Manager:

Carlos H Westhelle

Project Manager:

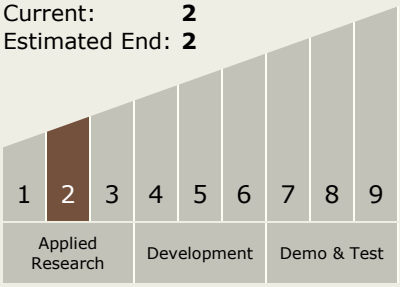
Jer-chyi Liou

Principal Investigator:

Jer-chyi Liou

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **2**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.1 Guidance and Targeting Algorithms
    - TX17.1.2 Targeting Algorithms